noted Applicant's arguments that some of the cited references are not prior art, the Examiner has not responded to those arguments. Accordingly, the finality of the rejection is premature. Thus, Applicant respectfully requests that the finality of the outstanding Office Action be withdrawn and that the following remarks be considered as a response to a non-final Action.

Favorable reconsideration is respectfully requested of the rejection of claims 1-6, 9-10 and 16 as being anticipated by the Johnson patent and of claims 7 and 8 as being obvious over the Johnson patent. Applicant had noted that Johnson includes zinc in his compositions, that zinc is a fluxing agent and that all pending claims exclude fluxing agents in the compositions employed in the claimed methods. The Examiner appears to accept that Johnson includes zinc in his method. However, the Examiner has questioned whether zinc is indeed a fluxing agent and Applicant understands from the Action that upon receipt of evidence that zinc compounds are fluxing agents, the claims will be found patentable over the Johnson patent.

Zinc and compounds of zinc are well-known fluxing agents and many references to such may be obtained from a quick internet search. For example, the website "Zinc Information Centre" at http://www.zincinfocentre.org/zinc_applications.html (print-out enclosed) states, "zinc oxide is a fluxing agent in the preparation of frits and enamels for ceramic wall and floor tiles." The comment posted at http://www.potters.org/subject25297.htm (print-out attached), quotes from The Ceramic Spectrum, by Robin Hopper, p.146, as follows:

> Zinc Oxide. Zinc is primarily used as a fluxing agent for mid to high temperature glazes. It can, however, perform a dual function in the production of opaque glazes. It has a strong effect on many colorants, turning iron anywhere from pale yellow to mustard brown, chromium to brown, cobalt to grey blue, and nickel to blue, green or brown.

In its list of dry raw materials, Marjon Ceramics, Inc. (www.marjonceramics.com) identifies zinc oxide thusly:

> ZINC OXIDE ZnO
>
> A useful, high temperature flux. It increases the maturing range of glazes and produces bright, glossy colors. Also may be used to give opacity to glazes.

www.marjonceramics.com/pages/Product/rawmat.htm (copy enclosed). And Zaclon LLC (www.zaclon.com) repeatedly refers to zinc fluxing agents, including the following reference:

Zaclon LLC. manufactures the widest available range of solid and solution zinc ammonium chloride-based products, primarily used as galvanizing fluxes.

http://www.zaclon.com/prods_galvflux.html (copy enclosed). Attention is also directed to US patent 4,042,731, which is directed to "A process which involves galvanizing with a galvanizing flux consisting essentially of a fluxing material selected from zinc ammonium chloride double salt and a mixture of zinc chloride and ammonium chloride and, as a foaming agent, sorbitol by dipping a metal article into a molten bath of zinc covered by said flux." It is believe that such references are sufficient to satisfy the Examiner's request for evidence that zinc compounds are fluxing agents. Accordingly, it is believed that the patentability of the subject claims over the Johnson patent has been established.

Favorable reconsideration is also requested of the rejection of claims 1-10 as being obvious over the Buecker et al. article. As noted in Applicant's previous response, the Buecker et al. article is dated November 2000, which is less than a year prior to the effective filing date of the subject patent application and so is not prior art. Regardless, the article reports on a method of ADA Environmental Solutions, which appears to be the method of the Johnson patent discussed above, which was assigned to ADA Environmental Solutions. This would explain the results reported by Buecker et al. and the reference by Buecker et al. to the ADA compositions included "a mixture of iron oxides and stabilizing chemicals . . ." See page 2 of 4, last full paragraph, of the Beucker et al. print-out.

Prior art must be considered in its entirety. Thus, even were the Buecker et al. article prior art, the subject claims still are patentable over the Buecker et al. article for at least the reasons addressed above with respect to the Johnson patent, including the fact that the Johnson methods employed compositions that included an added fluxing agent (zinc). Accordingly, the Buecker et al. article does not render any of the subject claims unpatentable.

Although the Examiner has not stated why this rejection based on the Buecker article has been maintained over Applicant's arguments set forth in the previous response, it appears that establishment of zinc as a fluxing agent per the discussion above should satisfy whatever concerns remain with respect to the Buecker et al. article. Therefore, it is submitted that all pending claims define patentably over the Buecker et al. article.

Favorable reconsideration is also requested of the rejection of claim 1-10 and 16 as being obvious over the Radway et al. patent. The Examiner argues that the Radway et al. patent simply

teaches adding iron oxide to coal and combusting the coal and that this "is all that Applicant does." However, as explained in the preliminary remarks submitted prior to first Action in this case and repeated in the previous response, the method of the Radway et al. patent, as described in the patent's specification, defined in the patent's claims and illustrated in the patent's working examples, is the standard prior art technique over which the present invention provides an improvement –it is the coating of furnace wall ash with a darkening agent. For example, the Radway et al. Abstract states, "The method involves exposing the walls to a darkening agent, or a combination of a darkening agent and a fluxing agent." And, again, in the Field of the Invention, Radway et al. state that "the invention relates to a darkening agent for darkening highly reflective deposits of thin ash . . ." And, again, in the Summary of the Invention, Radway et al. state, "The method involves exposing the walls to a darkening agent, or a combination of a darkening agent and a fluxing agent."

Although Radway et al., in passing, mention that the darkening agent alone may be used to darken the ash, the examples teach only the use of the darkening agent *with* a fluxing agent. The fluxing agent allows the darkening agent to adhere to the ash. By contrast, the method of the present invention does not involve exposing the furnace walls to a darkening agent <u>and</u> a fluxing agent. Moreover, as noted in the subject specifications the composition increases the efficiency of heat transfer of the furnace. The composition appears to increased such efficiency by increasing the thermal conductivity of the ash on the furnace walls. Nowhere do Radway et al. teach, suggest or realize that by eliminating the fluxing agent, surprising results contrary to the understanding of the art –that the fluxing agent may be eliminated, that such elimination results in an elimination of a need for a darkening agent, and that such elimination results in greater heat transfer efficiency—are obtained. Radway et al. further do not teach or suggest formation of calcium ferrite. The Radway et al. patent is directed consistently and single-mindedly to coating reflective ash build-up with a darkening agent and a fluxing agent.

Nor do Radway et al. provide any hint as to how to carry out its method (e.g., with respect to concentrations, type of iron ore, and techniques), let alone the claimed method. Radway et al. simply did not appreciate that if iron oxide were added to the coal in the proper amount, it would form calcium ferrite upon combustion of the coal, thereby obviating the need to coat white ash as it directs, and nothing in the Radway et al. patent so teaches or suggests. This surprising result is sufficient to establish patentability. Accordingly, in view of the foregoing,

withdrawal of the finality of the previous rejection, favorable reconsideration and withdrawal of the outstanding rejections, and early allowance of the subject application are earnestly solicited.

Respectfully submitted,

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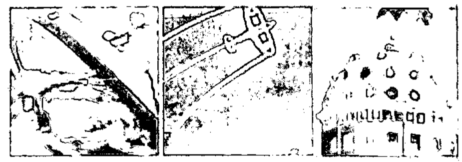
Attachments

zinc
information centre

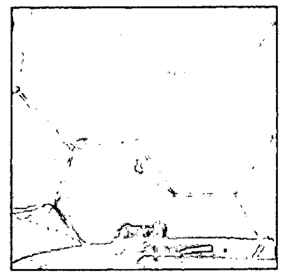


Applications

Zinc Coatings

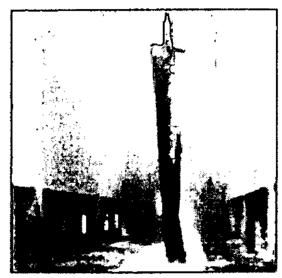
Zinc coatings for iron and steel provide excellent corrosion resistance in most atmospheres, in hard fresh waters, and in contact with many natural and synthetic substances. Zinc coatings are widely used to protect finished products ranging from structural steelwork for buildings and bridges, to nuts, bolts, strip, sheet, wire and tube. The electrochemical relationship between zinc and steel enables zinc coatings also to protect steel at cut edges and at breaks in the coating by a sacrificial action. (See also Zinc anodes: cathodic protection)

The following are the seven principal methods of applying zinc coatings:



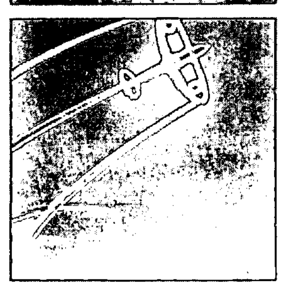
Batch (or 'General') hot dip galvanizing

Individual steel components or fabrications are chemically cleaned by acid to remove rust and millscale before being immersed in a bath of molten zinc at about 450°C. In the galvanizing bath a series of zinc-iron alloy layers are formed by a metallurgical reaction between the iron and zinc. As the steel is withdrawn, a layer of molten zinc remains on the surface.

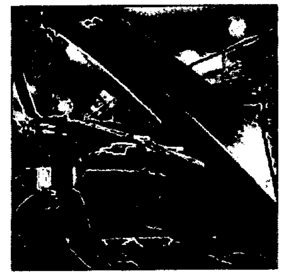


The metallurgical bond between the base steel and the coating means that in addition to excellent corrosion resistance hot dip galvanized coatings are much less susceptible to handling damage than other coatings such as paint systems. Applications include structural steelwork, lampposts, crash barriers, power transmission towers, railway electrification supports, security fencing, trailers and many others.
Galvanizing offers duel protection against rust. Firstly, the coating covers the whole surface, reaching into even the most awkward corners of complicated structures, and provides an impermeable barrier between the basis material and the atmosphere which corrodes at a much slower rate than steel. Secondly, because of its electrochemical properties, zinc will sacrificially protect any small areas of damage and the coating may even self heal. Even when the exposed area is too wide to allow self-healing, these properties prevent the sideways creep of rust beneath the zinc coating.

Continuous hot dip galvanizing



After several preparatory stages, clean, non-oxidised steel strip is passed at high speed through a molten zinc alloy bath, wiped to control the coating thickness and cooled to form a thin, continuous zinc (or zinc alloy) coating. Depending on the final use, various thermal or chemical treatments may be applied. Continuous paint or plastic coatings may also be applied at the production plant to provide additional protection and/or a coloured finish. Applications include roofing and cladding for industrial and commercial buildings, domestic appliances and automotive bodies. All car manufacturers now



use steel strip that has either been continuously hot dip galvanized or zinc plated.

Zinc Spraying

Atomised particles of molten zinc are projected on to a grit-blasted steel surface from a special flame or arc pistol fed with zinc or zinc alloy wire. The process is often applied to structural components too large to be dipped in a galvanizing bath, and to structures which are likely to distort during hot dip galvanizing.

Zinc plating (Electrogalvanizing)

The zinc coating is electrodeposited onto prepared steel from a solution of zinc salts. The process is used to protect smaller articles - such as nuts, bolts and other fasteners and small pressings – which require a finer finish than galvanizing can normally provide, although the coating is thinner. The process has also been adapted to provide thin coatings on steel strip and wire.

Sherardizing

Prepared iron or steel articles are heated with zinc dust and sand in a slowly rotating drum at a temperature just below the melting point of zinc until the zinc has formed a zinc-iron alloy coating over their surfaces. The coating is very even, matt-grey in appearance and is mainly used for fairly small articles because of the difficulty of heating the contents of large drums evenly.

Zinc-rich paints

These are paints in which very high levels of fine zinc dust have been incorporated. Because of the very high pigmentation with zinc particles , the dry film is electrically conductive and so acts to some degree as a metallic coating. Zinc dust paints can be applied to any rust and scale-free steel surface by brushing, spraying or dipping. They are mainly used to protect factory steel work, ship's hulls and parts of car bodies and also to repair damage to other types of zinc coatings.

Automatic grit blasting and zinc dust paint spraying equipment are widely used in steel workshops and shipyards to protect steel plates during storage before fabrication and until application of the final coating system.

Mechanical plating

Steel articles are cleaned and then given a very thin coating of copper by immersion in a copper sulphate solution. Zinc is then impacted onto the surface by tumbling with a mixture of zinc dust and ballotini (the tiny glass beads that are used in reflective paints) in an aqueous medium. A thin even coating is formed. The treatments are carried out at room temperature so there is no risk of softening tempered steel articles such as springs

Zinc alloy die castings

Pressure die casting, is a fast economical process for mass producing accurate parts. Molten metal is forced under pressure into permanent steel dies which are opened mechanically to allow the casting to be ejected. When

specially developed zinc alloys - based on zinc of at least 99.99% purity, with additions of aluminium, magnesium and sometimes copper - are cast using the hot chamber variant of this process, the resulting parts can be not only uniquely accurate but also strong and with excellent corrosion resistance. When required for functional or aesthetic reasons, zinc die castings can accept a wide range of surface finishes including plating, painting and plastic coating.
Given this combination of strength, accuracy, consistency and finishability, it is not surprising that zinc alloy die castings are used in a vast range of applications: in car manufacture for handles, locks, carburettors, fuel pumps, etc.; in domestic appliances; for locks, door handles, bathroom fittings and other items of builder's hardware; and in a variety of other products including scale model toys and zip fasteners.

Other zinc alloys

In addition to the pressure die casting alloys there are three alloys containing approximately 8, 12 and 27% aluminium that are used for traditional sand castings or gravity die castings. With their relatively low melting points and competitive mechanical properties, they can be sometimes be used as alternatives to aluminium, cast iron or brass, thus saving energy and production time. Exceptional fluidity allows thin wall castings to be made when required. If needed, secondary finishing operations like machining are easy and heat treatments are rarely required.

A zinc alloy containing of 30% aluminium and 5% per cent copper (known in the United Kingdom as Alzen 305) can be used to replace phosphor bronze in some bearing applications, particularly for high loads and low speeds. This alloy can also be extruded.

Zinc alloys based on 22% aluminium display marked superplasticity at 260°C after preparatory heat treatment. In sheet form they can be vacuum of blow-moulded in cheap dies, taking advantage of the 1000 per cent elongation available. These alloys have found niche markets, particularly replacing other sheet metal in equipment housings.

Brass

Brasses are copper-zinc alloys with a zinc content ranging from about 20 to 40%, and sometimes containing additions of other metals. Alpha brasses with 28 to 37% zinc content are single-phase alloys suitable for cold working (i.e. rolling, pressing and drawing), and for small castings. The alpha-beta brasses with 40 to 45% zinc content consist of two phases and are suitable for casting, hot pressing and extrusion.

Brasses are easily recognised by their yellow colour and – because of their ease of working, high corrosion resistance and good electrical conductivity – are widely used in a wide range of engineering applications as well as for plumbing and electrical components. For further information on brass visit Copper Development Association on www.brass.org.

Zinc oxide

Zinc oxide is the most important compound of zinc. It is an indispensable raw material for a multitude of everyday products and is produced in a number of different 'grades' of purity and particle size depending where it is to be used.

Zinc oxide is made by heating zinc metal or residues containing metallic zinc to temperatures beyond the boiling point of 907°C. The zinc vaporises and is allowed contact with the air: it oxidises and is cooled, collected and graded.

Applications include:

Glass and ceramics: zinc oxide is a fluxing agent in the preparation of frits and enamels for ceramic wall and floor tiles.

Rubber and tyre products: zinc oxide is essential. It is an activator in the vulcanisation process, putting the 'bounce' into the rubber. Other benefits include improved physical properties and resistance to degradation.

Electronics: high purity grades of zinc oxide are used in specialised applications such as ferrites and in varistors to protect sensitive equipment from electrical power surges.

Pharmaceuticals and cosmetics: for example suntan lotions (to absorb ultraviolet radiation), baby creams and antiseptic healing creams.

Nutrition: zinc is an essential micronutrient for plants and animals and humans. Zinc oxide is a convenient form in which to add zinc to fertilisers and animal feeds to avoid deficiency. It is also used in the preparation of other zinc compounds used in the preparation of dietary supplements for humans

Zinc dust

As for zinc oxide, zinc dust is made by vaporising metallic zinc. However the vapour is in this case allowed to condense in the absence of air, when it forms a fine powder.

The principal uses of zinc dust are in paints and sherardising (See under Zinc Coatings). It is also used in alkaline batteries and as a chemical reducing agent

Zinc phosphate

Zinc phosphate is essentially produced by reacting zinc oxide with phosphoric acid, followed by precipitation, filtration and drying. It is available as a product in various states of hydration. Zinc phosphate is mainly used in solvent or water-borne anti-corrosive primer systems and paints.

Zinc sheet: roofing

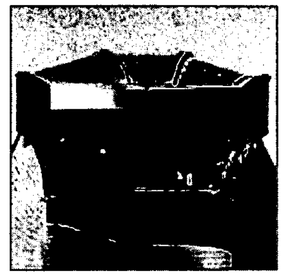
The main use of rolled zinc sheet and strip is for roofing, cladding, flashings, and rainwater disposal applications. It has been used extensively for these purposes in continental Europe for many years. Now, with increased awareness of its technical and aesthetic qualities, its use is rapidly increasing in the UK.

The product is used today is a zinc–copper-titanium alloy. This conforms to a European standard – EN 988, which covers such factors as surface finish, dimensional tolerances, tensile and creep strength.

In addition to its technical qualities zinc sheet offers the advantages of excellent visual appearance, long life with minimal maintenance, cost effectiveness, and a versatility which enables it to be used confidently for innovative architectural designs.

Whilst the main tonnage of zinc sheet is used for architectural

purposes it has a wide range of other applications, including electrical and engineering components, printing, organ pipes, coffin linings, gaskets, stencils, bar and table tops, with new uses continually being developed.

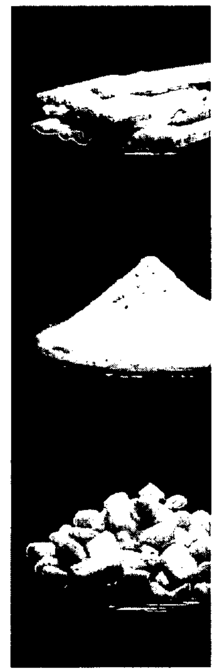


Cathodic Protection: Zinc Anodes

Because of their different positions in the electrochemical series, when zinc and iron or steel are joined together and placed in an electrolyte, a cell is formed in which the zinc becomes the anode and the steel the cathode. The zinc then dissolves preferentially ('sacrifices') and the steel does not rust. This is the process that enables zinc coatings to protect steel at damaged areas (See 'Zinc coatings')

Marine sacrificial zinc anodes, which are available in many shapes and sizes, are bolted onto ships' hulls and ballast tanks, rigs and other installations to protect the steel structure from corrosion. High purity zinc and a range of special alloys are used for cathodic protection to ensure that the surface remains active.

Galvanizing Fluxes



Zaclon LLC. manufactures the widest available range of solid and solution zinc ammonium chloride-based products, primarily used as galvanizing fluxes. Zaclon® zinc ammonium chloride products are also used by our customers for manufacturing other products, such as plumbing or brazing fluxes and electroplating solutions.

Hot-dip galvanizing involves reacting metallurgically clean steel or iron with molten zinc or zinc alloy. The normal hot-dip galvanizing process involves a cleaning/degreasing step, usually an alkaline metal cleaner; then rinsing, before descaling or "pickling" in hydrochloric or sulfuric acid. After rinsing, the treated surface is very active and forms light iron oxide layers rapidly. Zaclon galvanizing flux dissolves the oxides that may form on steel or iron, prevent further oxidation before galvanizing.The flux also helps reactions in the molten zinc, controlling formation of zinc oxides.

Fluxes are used as a "preflux", or solution flux and/or as a "topflux" or molten salt flux floating on the liquid zinc metal. The fluxing process creates a metallurgically clean steel or iron surface in the galvanizing kettle, allowing reaction with molten zinc at about 825° F and the formation of a high quality, fully alloyed galvanized coating.

Zaclon Galvanizing Fluxes are available in granular, rod and fine particle sizes. Zaclon fluxes are made in a variety of zinc chloride to ammonium chloride weight ratios, and with special additive packages for specific customer needs. These products ship in 50 lb. bags, 400 lb. drums, and large supersacks.

Concentrated Zaclon solution fluxes are available in any ratio of zinc chloride to ammonium chloride, and can be shipped in railcars, bulk trucks, bulk drums or drums. Special solution fluxes with unique wetting agent packages and other additives have been formulated for the needs of the continuous sheet and wire galvanizing operation, including products thermally stable for preheating up to 600° F.

Zaclon® Galvanizing Fluxes are widely used throughout the world for general job shop galvanizing for small parts, structures, tubes and pipe; and for continuous galvanizing operations for wire, fencing, sheet and tube. Zaclon® galvanizing fluxes are also used as building blocks for a wide variety of brazing, soldering, and welding fluxes.

Other Zaclon Specialty Fluxes

Zaclon LLC. also produces specialty fluxes for specific needs.
»Sulfate Control Flux: formulated with additives for the job shop using sulfuric acid for pickling.
»High Speed, Kleanrol, and Zaclon A-type fluxes are used in continuous and batch hot-dip terne (lead-tin) and high-tin coating.
»Zaclon ZR is a patented flux for operations using high aluminum zinc alloys, such as Galfan alloy from ILZRO (International Lead Zinc Research Organization) and "Galvalume" coating lines.
»Zaclon AB is a low-smoke flux, often used for reducing zinc metal losses in zinc ashes.

Download MSDS & Datasheets

Zaclon AB Flux Datasheet
Ammonium Chloride Solutions Datasheet
Ammonium Chloride Techical MSDS (Spanish Translation
Zaclon Galvanizing Fluxes Datasheet
Zaclon Start Up Flux Datasheet
Zaclon Sulfate Control Flux Datasheet
Zaclon AB Flux MSDS
Zaclon Galvanizing Flux C Solution MSDS
Zaclon Galvanizing Fluxes (A,AF) MSDS
Zaclon Galvanizing Fluxes (K,K6) MSDS
Zaclon Galvanizing Fluxes (K,K6) MSDS(Spanish Translation)
Zaclon Galvanizing Fluxes Solution W MSDS
Zaclon High Temperature Galvanizing Flux Solution MSDS
Zaclon Galvanizing Fluxes - Start Up Flux MSDS
Zaclon Galvanizing Flux - Zaclon Sulfate Control MSDS
Zaclon K, K-6 or F Galvanizing Flux Solutions MSDS
Tin/Zinc Copper Alloys MSDS
Zaclon ZR Flux Solution Datasheet
Zaclon W Datasheet
High Speed Datasheet
High Speed MSDS
Zaclon WRP Data and MSDS
Alloy Repair Rod Datasheet

ZACLON LLC
1.800.544.2203
2981 Independence Road, Cleveland, Ohio 44115

RAW MATERIALS

INTRODUCTION
As a major supplier of raw materials to the ceramic industry, we strive to offer our customers consistent, top quality materials that are competitively priced. On the following pages you will find a listing of chemicals and materials currently available from Marjon Ceramics. These products are listed in the following sub- categories: Materials, Raw Clays, Frits and Stains. It was our intention in preparing this section to give you, the user, as much information as possible about these products. Where available from the supplier, the chemical formula of the material is given. We hope this section is useful to you as a reference guide to the materials which are relevant to the ceramic field.

LIABILITY STATEMENT
The materials available through this catalog are in grades of purity which are most useful in the ceramic industry. Some of them are not "pure" compounds and therefore, we are unable to warrant the consistency of these materials from batch to batch. We urge you to make thorough tests every time a new material or lot is purchased.

SAFETY
Some of the products listed in this catalog are noted as being TOXIC, and special precautions should be taken when handling them. However, even though a chemical may not be specially noted as being TOXIC, it may still be harmful if ingested and a NIOSH approved mask should be used when dust or mist is present. Material Safety Data Sheets (MSDS) are available upon request.

DRY RAW MATERIAL

ALUMINA HYDRATE $Al(OH)_3$
The usual source of alumina in glazes.

ALUMINA OXIDE Al_2O_3
Responsible for the mattness or brilliance of glazes. Prevents devitrification and adds strength, insoluble in water and melts at 3550 F. Use of too much alumina can cause a dry appearance.

AMMONIA CITRATE (Ammonium)
A deflocculant for iron bearing glazes or bodies to control iron segregation.

BARIUM CARBONATE $BaCo_3$
This is the main source of Barium Oxide in glazes. It functions as a flux and assists in producing matt finishes. German barium may also be used to neutralize sulfates in clay bodies.

BENTONITE $Al_2O_35SiO_27H_2O$
A very plastic magnesium clay containing colloidal matter which in small amounts lends plasticity to a clay body. Also used as a suspending agent in glazes. We recommend bentonite 325 mesh as a standard glaze and clay additive.

BONE ASH $Ca_3(PO4)_2$

An important source of phosphate. When added to a clay body such as bone china, it lowers the maturing temperature and adds translucency. Also used to give texture in low fire glazes.

BORAX $Na_2B_4O_7$
A water soluble, low temperature flux which lowers the fusion point of glazes and promotes a smooth melt. Produces bright colors with oxides. Also a source of sodium and boric oxide in glazes. Available in granular and powder.

C.M.C. POWDER
An organic cellulose gum which functions as a thickener, a binder and suspending agent in glazes. Mix with water to dissolve and age before adding to a liquid glaze.

CALCIUM CARBONATE $CaCo_3$
The most common source of calcia in glazes. It is a high temperature flux which gives durability and hardness to glazes. Includes whiting, vircon and marblewhite.

CALCIUM NITRATE $Ca(No_3)4H_2O$
A water soluble compound that is used as a thickener in glaze preparation.

CALCIUM ZIRCONIUM SILICATE $CaMgOSiO_2ZrO_2$
This opacifier produces a different result than whiting and can be used singularly in the high temperature range up to cone 10. The compound can be combined with other zirconium products; it can also be used in low temperature glazes to produce zinc free matte finishes.

CHROME OXIDE-GREEN Cr_2O_3
A versatile colorant used in glazes to produce various green tints.

COBALT CARBONATE $CoCo_3$
A fine particle, lavender powder used as a glaze colorant and for brushed decoration. Produces various shades of blue and where manganese is present can give purple.

COBALT OXIDE $Co3O_4$
A reliable, stable black powdered oxide. In small amounts it produces consistently strong blue tones. Used as a glaze colorant and brushing oxide decoration.

COBALT SULFATE $CoSo_47H_2O$
A water soluble reddish powder, sometimes used in white clay bodies and glazes to create a "whiter" appearance as a result of imparting a bluish tint; in other words, a cold white vs. a warm white.

COPPER CARBONATE $CuCo_3$
A green powder used as a glaze colorant. Depending on conditions and formulation it may produce green, blue-green or copper red.

COPPER OXIDE BLACK CuO
This is the oldest glaze colorant known. It is a strong flux and will produce fluid glazes. Can produce copper reds in reduction firing.

CORNWALL STONE NaK_2O Al_2O_3 $8SiO_2$

A type of spar used in clay bodies to give strength while firing. Also used in engobes because of its adhesive properties. With tie addition of a suitable flux, cornwall stone can be used as a glaze. Sometimes called English Cornish Stone.

CRYOLITE Na_3AlF_6

Synthetic Cryolite (Kryolite). A strong fluxing agent with a very low melting point. A good sodium-alumina source. Occasionally used as an opacifier for enamels, or to produce crackle glazes.

DEXTRIN

A binder used mostly with plaster.

DOLOMITE $MgCa(CO_3)2$

Useful as a source of calcium and magnesium. It can be used as a high temperature flux and also to promote crystal formations.

DYES (Water Soluble)

Aniline Dye Brown	Blue 2-B Methylene	Methyl Violet 125%
Black-12525	Red Rhodamine B	Yellow Auramine
Green M Victoria		

(The above colors are commonly used by manufacturers to color code similar appearing clay or glaze batches.)

FELDSPARS:

Crystalline minerals made up of mainly alkaline silicates. Used extensively in both clay and glaze formulation.

CUSTER

A standard potash spar used in clay and glaze formulas. Mined in Custer, South Dakota.

G-200

A potash spar, low in impurities, well suited for white glazes and porcelain clay bodies.

PRIMAS P

A Mexican potash feldspar for use in clay bodies and glaze formulas.

PRIMAS S (Soda Spar)

A Mexican soda spar, an economical substitute for eastern soda spars in most formulas.

FELDSPAR ANALYSIS CHART

NAME	SILICON DIOXIDE SiO_2	ALUMINA OXIDE Al_2O_3	IRON OXIDE Fe_2O_3	CALCIUM OXIDE CaO	MAGNESIUM OXIDE MgO	SODIUM OXIDE Na_2O	POTASSIUM OXIDE K_2O	LOSS ON IGNITION
Custer	68.5	17.5	0.08	0.03	Trace	3.00	10.4	0.3
G 200	67.5	18.5	0.09	1.15		3.24	9.4	0.2
Primas P	66.5	18.5	0.077			3.50	10.31	0.1

Primas S	68.5	17.0	0.375	0.40	0. 40	6.40	5.40	0.1

FLUORSPAR CaF_2

This crystalline mineral has a lower fluxing temperature than other calcia compounds. It can be used as a substitute for whiting to promote more fusible glazes. Insoluble in water, it should be used at 100 mesh or finer or can cause modeling in glazes.

GERSTLEY BORATE $Na_2O\ 2CaO\ 5B_2O_3\ 16H_2O$

A sodium-calcium-borate compound used as a low temperature flux which helps prevent crazing. Can act somewhat as an opacifier. Standard substitute for Colemanite.

GROGS:

A hard fired clay which is crushed to various mesh sizes. Add to throwing and sculpture clay bodies to increase working strength and reduce shrinkage. Also aids in drying thick pieces.

BUFF

A fire clay grog with a particle size ranging from approx. 20 to 90 mesh.

IONE 400 (20F)

Medium grind 20 mesh to fines. Grey-white in color.

IONE 406 (65F)

Extra fine grind 65 mesh to fines. Grey-white in color.

IONE 412 (35F)

Fine grind 35 mesh to fines. Grey-white in color.

IONE 420 (20X48)

Coarse grind 20-48 mesh grog. Grey-white in color.

RED IMCO

Ground ceramic sewer pipe grog. Fired to cone 9. Precision ground to finer than 48 mesh.

GUM ARABIC

A powdered natural gum material used as a binder and suspending agent in glazes.

GUM TRAGACANTH

An organic substance extracted from a tree which grows in Levant. It acts as a type of glue and is used as a binder for glaze-fit to clay bodies during firing. It is a good emulsifying agent.

ILMENITE $FeTiO_3$

A material used to produce specks in glazes above cone 4 firing temperatures. Available in granular and powder.

IRON CHROMATE $FeCrO_3$

Produces dark colors in engobes and underglazes. Can also be added with manganese compounds to clay bodies as a colorant.

IRON OXIDES:
YELLOW Fe_2O_3
A weaker form of iron - high clay content.

BLACK 5599 Fe_3O_4
Ferrous oxide. Produces various shades of brown or green when used as a glaze colorant or decorative oxide. In high fire matt glazes, iron oxide and titanium can produce reddish colors.

RED 4284 Fe_2O_3
Ferric oxide. Basically the same as black iron oxide except not as concentrated. 82%-86% natural and synthetic iron oxides. Our standard red iron oxide.

BROWN 521 Fe_2O_3
A natural iron oxide. Reddish-brown raw color.

KRYOLITE (See Cryolite)

KYANITE $3Al_2O_3SiO_2$
A refractory material used to reduce shrinkage in clay bodies and give strength to the body. Can form mullite during firing. Available in 48 and 200 mesh.

LEAD CARBONATE (White Lead) $2PbCO_3Pb(OH)_2$
A once important raw material but now seldom used due to high toxicity. It is a strong flux which promotes an extremely smooth glossy finish.

LEAD MONOSILICATE PbO O $67SiO_2$
This is a fritted source of lead and silica which is safer to handle than raw lead because it is bonded in a glass. The melting point is 725-750 degrees C. Lead monosilicate is free from un- combined lead oxides and silica.

LITHARGE PbO
Yellow lead monoxide. A source of lead in frits. Contains impurities and has a larger particle size than lead oxide, but is often used for the same purposes.

LITHIUM CARBONATE Li_2CO_3
Used as a flux in leadless glazes. It is a source of lithia which is a strong high temperature flux. Improves the brightness of glazes and increases the firing range. Also reduces thermal expansion. Available in fine or coarse.

MACALOID
A suspension agent which increases the drying rate of water suspended glazes. It is similar to a very clean, white type of bentonite.

MAGNESIUM CARBONATE $MgCO_3$
Common source of magnesium in glazes. Imparts strength and color with little shrinkage. In larger proportions, it produces a dry opaque quality in glazes.

MAGNESIUM SULFATE $MgO4S7H_2O$
Also known as epsom salts, it can thicken a glaze to improve adhesion to non-porous surfaces. Also acts as a suspension agent.

MANGANESE CARBONATE $MnCO_3$
A weak coloring agent. In an alkaline glaze, a blue-purple or plum color can be obtained. In leadless glazes, a purple brown may result. It is a powerful flux.

MANGANESE DIOXIDE MnO_2
A black powder which gives red, brown, purple or black tones to clay bodies and glazes. A strong flux when added in large amounts to clay bodies.

MICA (325) $K_2Al_4Al_2Si_6O_{20}(OH)_4$
Water ground, 325 mesh powder. Usually added to a glaze formula to aid in craze resistance. Also helps thermal and moisture expansion resistance.

MULLITE $3Al_2O_32SiO_2$
Virginia 35 mesh mullite can be added to a clay body to check thermal expansion. It adds strength because of the needle-like shape of its crystals. (Calcined Kyanite)

NEPHELINE SYENITE K_2O $3Na_2O$ $4Al_2O$ $9SiO_2$
Similar to a soda spar. It can reduce crazing tendencies when added to a clay body. Also used in glazes where a soda spar is required.

NICKEL CARBONATE $NiCo_3$
Common glaze colorant. Green nickel produces a variety of browns, blues, grays and yellows depending on the presence of other materials in the glaze.

NICKEL OXIDE NiO
Black nickel produces browns, blues, grays and yellows in glazes. It can also tone down more intense colorants such as cobalt and copper. Maximum use is usually 3%.

PETALITE Li_2O Al_2 O_3 $8SiO_2$
A lithium feldspar which is used both in clay bodies and glazes to help decrease thermal shock problems.

POTASSIUM CARBONATE K_2CO_3
Also known as pearl ash, it is a strong flux and can be used as a color modifier in glazes.

PUMICE $Al_2O_34SiO_22H_2O$
Also known as volcanic ash, it is a type of feldspar which can be used in glazes. It is not desirable in clay bodies.

PYROPHYLLITE Al_2O_3 $4SiO_2H_2O$
An aluminum silicate which is added to clay bodies to reduce thermal expansion.

RAW SIENNA
An iron-bearing clay which is used as a colorant in engobes, stains, underglazes and overglaze

decoration.

RUTILE, CERAMIC GRADE TiO_2
An impure titanium dioxide tan colorant which contains a small amount of iron. Used both for color and its tendency to provide various mottled textures.

SANDS:
Relatively pure silica sands which can be used in place of grog in clay bodies to add texture and strength. Begins to soften at cone 10.

CRYSTAL 30 MESH
Coarse 30 mesh silica sand.

CRYSTAL 60 MESH
Medium 60 mesh silica sand.

CRYSTAL 90 MESH
Fine 90 mesh silica sand.

SILICA SiO_2
Also known as flint, this is the most common source of silica in clay bodies and glazes. Increases the thermal expansion in clays and decreases the thermal expansion in glazes. Also used to raise the melting point in glaze. Available in 200 and 325 mesh.

SILICON CARBIDE FFF SiC
A reduction agent used in glazes. Ground to 450-600 mesh. (FFF)

SODA ASH Na_2CO_3
Sodium carbonate. This is an active flux which serves an important function as a deflocculant in preparing liquid slip. It increases strength and workability and reduces shrinkage.

SODIUM BICARBONATE $NaHCO_3$
Baking soda. Used in making Egyptian paste clays.

SPODUMENE $LiAlSi_2O_6$
A source of lithia, which is a flux, that helps to develop copper blue tone glazes. Can replace feldspar and also reduces the vitrification temperature and shrinkage rate in glazes. Chemical grade.

STRONTIUM CARBONATE $SrCO_3$
Similar to calcium. Good in cone 1 to cone 10.

SUPERPAX $ZrSiO_4$
A popular zircon opacifier that's used in a wide variety of applications. It's effective in controlling texture, craze resistance and color stability in glazes.

TALC: $3MgO4SiO_2H_2O$
CT-30

A California talc, white to off-white in raw form (white when fired) and low in organic material. CT-30 is a platy talc which is used by itself or in combination with westex and pioneer talcs, and is a major component in low fire casting and moist clay bodies.

PIONEER
A white burning Texas talc low in calcium and grey in unfired state. Yields good green strength and plasticity. Used in Marjon slip (item #'s 1&2).

TIN OXIDE SnO_2
The most effective opacifier to produce even, opaque, glossy glazes. The normal use of tin oxide in a glaze is between 5% and 10%. A dull mat glaze can result when used in excess.

TITANIUM DIOXIDE TiO_2
Insoluble in water. Important opacifier. Often used in glaze to affect acid resistance, color and texture.

TRI-CALCIUM PHOSPHATE $Ca_3(PO_4)_2$
Similar to bone ash, it will work well in high or low temperature glazes. A white amorphous powder. Insoluble in cold water, decomposes in hot water. Produces phosphate and has successfully been used to replace tin oxide in some raw, leadless sanitary ware glazes maturing at 2280 degrees Fahrenheit. When used in most bases (8-15%) will produce a lava effect at cone 06.

UMBER, BURNT
A hydrated ferric oxide with manganese dioxide. It is used for brush decoration to produce a reddish-brown. Also can be added to clay bodies to achieve a darker color.

VEEGUM
A macaloid type bentonite suspension agent for glazes. Also used as a surface hardener. It is an extremely plastic, hydrous magnesium silicate used to give plasticity to non-plastic whiteware and refractory bodies. Very similar to macaloid.

VERMICULITE $4O_{10}(OH)_2 4(H_2O)$
Exfoliated mica, a low refractory insulating material used for exterior kiln insulation. Also used as a filler to reduce weight of plaster of cement products.

WHITING $CaCO_3$
(See Calcium Carbonate)

WOLLASTONITE $CaSiO_3$
A natural calcium silicate used to reduce shrinkage in clay bodies and glazes during firing. Can replace silica and whiting. Also aids in fast firing of clay bodies.

ZINC OXIDE ZnO
A useful, high temperature flux. It increases the maturing range of glazes and produces bright, glossy colors. Also may be used to give opacity to glazes.

ZINC ZIRCONIUM SILICATE $ZnZrSiO_5$
An opacifier which gives brilliance to the color of a glaze. Usually combined with other zircon compounds.

ZIRCOPAX $ZrSiO_4$
The original zirconium opacifier. Used mostly where semi-opaqueness is desired.

LIQUID RAW MATERIALS

CALCIUM NITRATE SOLUTION $Ca(NO_2)_2\ 4H_2O$
Sets the poise (reducing settling, running, etc.) in dipping and spraying glazes. Used as an oxidizing agent in zircon and titania opacified enamels.

COBALT SULFATE SOLUTION $CoSo_4\ 7H_2O$
A liquified cobalt compound often used to color white clays and glazes with a blue tint. Additionally, it is used as a decolorizer in clay bodies. Also assists spray solutions for art pottery.

DARVAN (Dispersal)
A deflocculant that is user friendly because it has a wider deflocculation curve. Does not deteriorate molds as actively as does sodium silicate.

GLYCERINE $C_3H_5(OH)_3$
Used to set and harden the surface of glaze and overglaze to facilitate faster glazing procedures.

GUM SOLUTION (CMC)
A liquified binder, thickener, suspension and brushing medium agent made of an organic cellulose gum. Also used to increase plasticity of clay bodies.

PLASTILUBE
This product is a concentrated mold release product. Suggest diluting 3 to 1 with water.

SODIUM SILICATE $Na_2O\ SiO_2$
Liquid "N" brand sodium silicate is used as a major deflocculant in preparing slip. It reduces the amount of water needed, therefore reducing shrinkage. This is a pure sodium silicate and must be mixed with water to a 50/50 solution for most casting bodies.

WAX RESIST
A wax emulsion. This wax resist is an excellent, ready to use product. It has the results of paraffin wax without the mess or danger of heating.

Go to the top of this page.
Return to the Product listing.

search current discussion categories glazes - cone 4-7

zinc oxide & cone 6

updated sun 31 oct 99

amy parker on thu 28 oct 99

I have been reading the posts about zinc oxide really being "useless" in a glaze, since it burns off during the firing, as I understand it from reading the posts. I am working with a cone 6 glaze that calls for about 10% zinc oxide, and I hate the process of having to screen it dry before adding to the glaze mix. From what I was reading, I should be able to just leave it out with no effects? Or did I miss something and this was maybe only for cone 10 reduction that it burns out?

Amy, sad that the Braves were swept, but glad they made the Series again!
amy parker Lithonia, GA
amyp@sd-software.com

Wendy Hampton on fri 29 oct 99

My understanding is that zinc oxide creates crystals at cone 6 if you soak it
for an hour and the end of the firing. It works on the glazes I have tried.
Wendy

David Hendley on fri 29 oct 99

The posts about zinc oxide volatilizing apply only
to reduction firings.
Even then, I'm not convinced that zinc oxide is
'useless'. Even if it eventually goes away, it might
still be having an effect on the initial melt or the
way the glaze sinters.

--
David Hendley
Maydelle, Texas
hendley@tyler.net
http://www.farmpots.com/

----- Original Message -----
From: amy parker
To:
Sent: Thursday, October 28, 1999 12:47 PM
Subject: zinc oxide & cone 6

| ----------------------------Original message----------------------------
| I have been reading the posts about zinc oxide really being "useless" in a

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| cone 10 reduction that it burns out?
|
| Amy, sad that the Braves were swept, but glad they made the Series again!
| amy parker Lithonia, GA
| amyp@sd-software.com
|

Ron Roy on fri 29 oct 99

Hi Amy,

It's when zinc oxide is reduced that the problem arises. This is not to say it can't happen to some degree in oxidation firings - this is probably the reason pinholing is blamed on zinc - and why it is recommeded to keep the amount no more that 2%.

There is no reason you cannot have clean firings - I would think using a vent would do a lot to prevent zinc reduction.

No reason you have to screen dry - mix it in with the water and use a paint mixer in a drill before you screen.

RR

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for
>cone 10 reduction that it burns out?

Ron Roy
93 Pegasus Trail
Scarborough
Ontario, Canada
M1G 3N8
Evenings 416-439-2621
Fax 416-438-7849

Jeff Lawrence on fri 29 oct 99

Amy Parker was wondering about zinc oxide at lower temps than cone 10

Hi Amy,

I have some ^04 glazes that look good in electric oxidation, wretched in gas oxidation. I attribute the difference to the zinc oxide.

Best
Jeff
Jeff Lawrence Sun Dagger Design
jml@sundagger.com Rt. 3 Box 220
www.sundagger.com Espanola, NM 87532
vox 505-753-5913 fax 505-753-8074

John Rodgers on sat 30 oct 99

Amy, the zinc oxide acts as a flux in electric oxidation. It works well with

many glazes in electric firings, but you are right, in a gas firing it burns
right out and goes up the chimney. If you are going to use gas...get rid of
the
zinc oxide

John Rodgers

amy parker wrote:

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> Amy, sad that the Braves were swept, but glad they made the Series
again!
> amy parker Lithonia, GA
> amyp@sd-software.com

Cerere@aol.com on sat 30 oct 99

FROM THE CERAMIC SPECTRUM by ROBIN HOPPER, p.146:

"Zinc Oxide. Zinc is primarily used as a fluxing agent for mid to high temperature glazes. It can, however, perform a dual function in the production of opaque glazes. It has a strong effect on many colorants, turning iron anywhere from pale yellow to mustard brown, chromium to brown,
cobalt to grey blue, and nickel to blue, green or brown."

Paul Lewing on sat 30 oct 99

Wendy Hampton wrote:
>
> ---------------------------Original message----------------------------
> My understanding is that zinc oxide creates crystals at cone 6 if you
soak it
> for an hour and the end of the firing. It works on the glazes I have tried.
> Wendy

Hi, Wendy.
This isn't quite exact, but you're on the right track. What most people think of as crystal glazes, those ones with the big spider-web crystals, are indeed zinc glazes, sometimes at cone 6, sometimes higher. But that's not all there is to it. In order to really get those crystals,
your zinc glaze must also have virtually no alumina, and the temperature must be dropped 100 degrees or so and held there for a while. Crystal glazes typically have a Si:Al ratio of 70 or so, sometimes even 100 or more, in contrast to most normal glazes' 5 to 15. By the way, the

opposite end of this ratio spectrum is the so-called "lichen glazes", with ratios around 2.
But firing any zinc glaze and soaking it would probably produce some crystals, probably more so than most other kinds of glazes. I have fired real crystal glaze recipes on my normal schedule and gotten, not the big webby crystals, but lots of smaller crystals that looked like snowflakes.
And for the information of the person who originally posted this thread, it's not that the zinc disappears at high temperature, it's that the least bit of reduction appears to convert the zinc oxide to the metal zinc, which boils off at a very low temperature. So zinc oxide could still be a useful flux even at cone 10, but only in oxidation.
Paul Lewing, Seattle